Canadian Stock Assessment
Proceedings Series 97/25

Évaluation des stocks canadien
Séries des comptes rendus 97/25

Report of the PSARC Groundfish Subcommittee Meeting November 24-28, 1997 and the Steering Committee Meeting January 6-7, 1998

M. Stocker and D. Welch (Editors)
Pacific Stock Assessment Review Committee (PSARC)
Pacific Biological Station
Nanaimo, British Columbia V9R 5K6

January 1998

Fisheries and Oceans Canada
Science

Pêches et Océans Canada
Sciences

Canada

102-06537/

Report of the PSARC Groundfish Subcommittee Meeting November 24-28, 1997 and the Steering Committee Meeting January 6-7, 1998

M. Stocker and D. Welch (Editors)
Pacific Stock Assessment Review Committee (PSARC)
Pacific Biological Station
Nanaimo, British Columbia V9R 5K6

January 1998

PACIFIC STOCK ASSESSMENT REVIEW COMMITTEE

PSARC ADVISORY DOCUMENT 97-5
DECEMBER 1997

PACIFIC GROUNDFISH

CONTENTS

I. STEERING COMMITTEE REPORT **2**

II. GROUNDFISH SUBCOMMITTEE REPORT **6**

1. BIOLOGICAL ADVICE ON MANAGEMENT OF B.C. GROUNDFISH FOR 1998 6

2. 1997 WORKING PAPERS AND AUTHORS 7

3. OVERVIEW OF CURRENT STOCK CONDITIONS 8

4. YIELD OPTIONS 9

5. MAJOR SUBCOMMITTEE CONCERNS 10

6. SUMMARIES OF ASSESSMENTS, REVIEWERS' COMMENTS AND SUBCOMMITTEE DISCUSSIONS 10
   - G97-2: Offshore Lingcod. *10*
   - G97-3: Pacific Cod *12*
   - G97-4: Flatfish. Fargo *14*
   - G97-5: Sablefish *17*
   - G97-6: Strait of Georgia Hake *20*
   - G97-7: Walleye Pollock *21*
   - G97-8: Slope Rockfish Status *22*
   - G97-9: Shelf Rockfish Assessment *27*
   - G97-10: Inshore Rockfish Assessment *28*
   - G97-11: West Coast Vancouver Island Rockfish *29*
   - G97-12: A Discussion Paper on Reconciling Management and Assessment of Inshore Rockfishes *30*
   - G97-13: Strait of Georgia Hook and Line Rockfish Fishery *33*
   - G97-14: Multispecies spatial assessment models. Walters and Bonfil *34*
   - G97-15: Fraser River Eulachons *35*

7. ADDITIONAL SUBCOMMITTEE DISCUSSIONS 36

8. APPENDIX 1. PARTICIPANTS AT THE GROUNDFISH SUBCOMMITTEE MEETING 43

9. APPENDIX 2. LIST OF REVIEWERS OF WORKING PAPERS 44

10. APPENDIX 3. CLARIFICATION OF ADVICE ON INSHORE ROCKFISH 45

I. STEERING COMMITTEE REPORT

The Steering Committee met January 6-7,1998 at the South Coast Division, 3225 Stephenson Point Road, Nanaimo, to review the Groundfish Subcommittee report. The report was accepted, with the following comments and recommendations.

Major Steering Committee Discussion and Concerns

1. Steering Committee notes that substantial progress is being made toward the inclusion of risk analysis in groundfish assessments (G97-8) and encourages further development of assessment approaches that explicitly include risk analysis.

2. As commentary on the following paragraph taken from the Subcommittee report,

   > *"The Subcommittee emphasized that for some stocks and fisheries, such as inshore rockfish, the biology of the species makes the present approaches to assessment and management inappropriate. Even with significantly greater resources it will remain impossible to provide advice to ensure sustainability with present approaches to estimating abundance and with quota management.",*[1]

   Steering Committee notes that G97-12 was prepared in response to the difficulties shared by agencies along the west coast of North America in reconciling the assessment and management of inshore rockfishes. The Steering Committee recommends that the proposals in G97-12 be further evaluated and developed for discussion among DFO sectors and stakeholders.

3. Management mandated changes in the conduct of many groundfish fisheries have seriously affected the continuity of assessment data series, which has, in turn, affected the credibility of assessments. Such data limitations lead Steering Committee to emphasize the importance of both observer programs and fishery-independent surveys. Steering Committee notes that considerable progress has been made in this area and that considerable opportunities exist for further improvements in concert with industry groups. Three working papers contain analysis of the trawl observer data (G97-4, G97-8 and G97-14). These analyses show that the observer data offer the potential for detailed understanding of harvest processes (fleet dynamics, catch composition and discarding). Fishery independent information (e.g. tagging and catch/effort surveys in sablefish, catch effort surveys in slope rockfishes, and Hecate Strait flatfish survey) performed in collaboration with industry has improved the nature of assessment advice (G97-4, G97-5 and G97-8). Such efforts should be strongly supported.

4. Steering Committee notes that one particular aspect of data limitation in inshore rockfish, and more generally for all groundfish, is the lack of information from creel

[1] At the PSARC/RMEC meeting on January 14th, 1998 RMEC requested clarification of the advice on inshore rockfish. PSARC's clarification is included as Appendix 3 in this Advisory Document.

surveys on species composition in recreational fisheries. Recreational catch data collection focuses on salmon. Most groundfish are not reported to species which is particularly problematic for estimating recreational catches of rockfishes. Steering Committee recommends that efforts be made to capture these data.

5. Steering Committee notes that PSARC has already sponsored a meeting on oceanographic issues in recognition of the need to better incorporate oceanographic and climatic information into assessments. Steering Committee strongly supports the formation of an Oceanography Working Group for the facilitation and acceleration of oceanographic information into fisheries assessments.

G97-2 Offshore lingcod stock assessment and recommended yield options for 1998.

Steering Committee accepts the yield recommendations and notes the reduced yield in area 3C, and that the overall status of offshore lingcod is consistent with a low to average interpretation of stock abundance.

G97-3 Hecate Strait Pacific cod stock assessments for 1997 and recommended yield options for 1998

Steering Committee accepts the yield recommendations and supports the continuation of the no directed fishery policy.

Steering Committee notes that there is a declining trend in abundance that began in the late 1980s and therefore urges caution in determination of allowable levels of incidental harvest.

Steering Committee notes that in areas where there has been no recent fishery that there are no data available with which to conduct an assessment. Consequently no advice can be provided for those areas.

Steering Committee shares the concerns of the Subcommittee over the low levels of biological sampling in the fishery, and the general lack of fishery-independent data, and stresses the importance of improving sampling programs to keep pace with management mandated changes in this fishery.

G97-4 Flatfish stock assessments for the West Coast of Canada for 1997 and recommended yield options for 1998.

Steering Committee accepts the yield recommendations but did request clarification of the Subcommittee reasons for their rejection of the authors' yield recommendations for area 5A/B rock sole. Although those explanations were satisfactory, Steering Committee did encourage the Subcommittee to, in future, more fully substantiate such decisions in their reports.

G97-5 Sablefish stock assessment for 1997 and recommended yield options for 1998.

Steering Committee accepts the yield recommendations. However Steering Committee notes discrepancies between the modeled biomass trajectories and fishery and survey trap CPUE trajectories, and recommends caution in the selection of yield options for 1998.

Steering Committee supports further investigations into sablefish population biology as necessary to resolve discrepancies between modeled and observed population dynamics.

Steering Committee notes that considerable progress has been made by Stock Assessment in collaboration with industry in improving the credibility of sablefish assessments.

G97-6 Pacific hake stock assessment for 1997 and recommended yield options for 1998.

Steering Committee accepts yield recommendations.

G97-7 Walleye pollock stock assessment for 1997 and recommended yield options for 1998.

Steering Committee accepts yield recommendations.

G97-8 Slope rockfish stock assessment for the West Coast of Canada in 1997 and Recommended Yield Options for 1998.

Steering Committee accepts yield recommendations.

Steering Committee endorses approach to risk assessment employed in this paper and encourages its application wherever data permit.

G97-9 Shelf rockfish stock assessment for 1997 and recommended yield options for 1998.

For 3B/3C Yellowtail rockfish, Steering Committee expressed concern over the apparent contradiction between stock trajectories and the 1998 yield recommendation. Steering Committee strongly cautions that projected biomass levels for 1998 are close to or below levels that would lead to cessation of fishing under precautionary approaches utilizing biological reference points. Steering Committee was unable to reconcile the 1998 yield recommendations with the stock status and trajectory, and so does not support their adoption. Further, because most Yellowtail rockfish are harvested in the offshore hake fishery, reductions in yield would have implications for that fishery.

For 3D/5E Yellowtail rockfish, Steering Committee notes that abundance indicators are trending downward, biomass estimates are uncertain, and the status of this stock is thought to be below average. For those reasons Steering Committee expresses concern that the recommended yield reductions are not suitably precautionary and recommends that considerable caution be used in selection of yield for 1998.

Steering Committee accepts yield recommendations for Widow rockfish.

Inshore Rockfish

G97-10 Inshore rockfish stock assessment for the west coast of Canada in 1997 and recommended yield options for 1998.

G97-11 Analysis of longline logbook data for the west coast Vancouver Island Yelloweye rockfish fishery.

G97-13 Analysis of Zn Hook and Line Logbook Data: Strait of Georgia Management Region.

These three Working Papers are closely related and Steering Committee dealt with them as a group.

Steering Committee concurs with Subcommittee concerns over the status of all inshore rockfish stocks but notes that in many areas and particularly in the North Coast, there are very little data available to confirm, or reject, perceptions of decline and localized depletions.

Data limitations are less severe within the Strait of Georgia, and Steering Committee supports Subcommittee recommendations stemming from G97-13, that substantial reductions in harvest by all user groups within the Strait are needed. However Steering Committee advises that there is no strong technical basis for recommending a specific reduction target.

Steering Committee notes that the assessment documented in Working Paper G97-11 is preliminary, pending the availability of historical logbook data for the west coast of Vancouver Island management region. Steering Committee advises that it cannot make further comment until the complete data series can be archived and analysed.

G97-12 A Discussion Paper on Reconciling Assessment and Management of Inshore Rockfish

Steering Committee recognizes the need to reform the assessment-management approach for inshore rockfish, and notes that this Working Paper is an important step in doing so.

Steering Committee highlights the need for a process to be developed to carry discussion of reform into a broader and more inclusive forum.

G97-14 Spatial Assessment Models for the B.C.

Steering Committee notes that development of multi-species spatial simulation models is an important step in improving the management of BC trawl fisheries.

However, Steering Committee notes that the particular approach developed in the Working Paper could not be fully evaluated, and that no specific management advice was forthcoming from the Subcommittee. Although interesting, the particular approach used in this model is only one of many potential approaches. Nevertheless, Steering Committee notes that multi-species spatial models are likely to become important in the management of fisheries and recommends that development of these approaches be encouraged.

Steering Committee notes that assertions that current coastwide trawl harvest is unlikely to be sustainable for at least some long-lived species could not be supported because the modeled "most probable Maximum Sustained Yield" on which the assertion is based was unacceptable due to the preliminary nature of the analyses, and in particular, the use of erroneous or inappropriate parameter values.

Steering Committee acknowledges that the Working Paper contains a considerable body of work, but notes that the revisions requested by the Subcommittee are substantive, and recommends that the revised Working Paper will require re-review prior to acceptance.

G97-15 Fraser River Eulachon Assessment.

Steering Committee requested clarification of the Subcommittee qualified endorsement of the methods presented in the Working Paper for the estimation of spawning biomass. Steering Committee notes that the use of egg and larval surveys shows promise for estimation of spawning biomass of eulachons, but that further work is required before the methodology will provide credible biomass estimates. Steering Committee recommends that such work be supported.

II. GROUNDFISH SUBCOMMITTEE REPORT

1. Biological Advice on Management of B.C. Groundfish for 1998

The Subcommittee met at the Pacific Biological Station, Nanaimo, from 24-27 November, 1997 to review the stock status and develop advice on groundfish resources for the Pacific Region. This advice is based on assessments and recommendations contained in working papers and peer reviews of these papers. This report includes summaries of both the papers and the reviews. There is a synopsis of the conditions of the assessed stocks and recommendations for management that were based on the working papers and discussions of the Subcommittee.

In 1991, the Groundfish Subcommittee initiated a multi-year schedule for groundfish stock assessments and yield recommendations. This schedule specifies that major updates for most stocks will occur on a staggered basis, with statistical updates (termed Interim Reports) of the fisheries in intervening years. Interim Reports will also provide information on any significant changes in stocks, particularly those that may require more frequent assessment revisions. Recommended yield options will normally remain unchanged between major assessments. In 1997 major assessments were conducted for Offshore Lingcod (G97-2), Sablefish (G97-5), Pacific Cod (G97-3), and Shelf Rockfish (G97-9). Several new reports dealing with aspects of the Inshore Rockfish fishery were reviewed (G97-11~13), as well as reports on an assessment of Fraser River Eulachon (G97-15), and a University of British Columbia report dealing with a simultaneous stock assessment of 14 species of groundfish (G97-14).

Groundfish staff in the Stock Assessment Division conduct their assessments using a multi-year data base of fishery statistics and biological sampling, and a variety of assessment tools including several catch-at-age models, age-independent biomass dynamic models, and yield-per-recruit models. Stock assessments are assigned to reviewers by the Subcommittee chair, and written review comments are provided to the authors prior to the Subcommittee meeting. Reviews for major assessments normally incorporate one external (government or non-government) and one internal reviewer. Assessments and recommended yield options are then reviewed by the Subcommittee, which includes representatives from management and outside reviewers. Beginning in 1997 the assessment meetings also include participants nominated from various sectors of the fishing industry with extensive practical experience in the fishery. These participants are prohibited from acting as industry advocates, but participate in the review as outside experts with considerable practical experience who can provide an additional perspective on the scientific assessments.

In earlier years the Subcommittee was required to reach a consensus on any recommendations presented in assessments before submission to the PSARC Steering Committee. Beginning in 1997 the terms of reference for the Subcommittee were revised, and the requirement for consensus no longer exists; instead the Subcommittee report will be written to reflect both majority and minority viewpoints. There is a standing membership for the Subcommittee, however, non-committee members may also participate in the Subcommittee meetings. A list of participants for the 1997 meeting is appended to the report.

2. 1997 Working Papers and Authors

Leaman, B.M. and G. A. McFarlane. 1997. Offshore lingcod stock assessment and recommended yield options for 1998. G97-2: 16 Pages, 11 Tables, & 8 Figures.

Haist, V. and D. Fournier. 1997. Hecate Strait Pacific cod stock assessments for 1997 and recommended yield options for 1998. G97-3: 9 Pages + Appendix, 8 Figures, and 11 Tables.

Fargo, J. 1997. Flatfish stock assessments for the West Coast of Canada for 1997 and recommended yield options for 1998. G97-4: 22 Pages, 10 Tables, and 21 Figures.

Haist, V., M. W. Saunders, R. Hilborn, and M. Maunder. 1997. Sablefish stock assessment for 1997 and recommended yield options for 1998. G97-5: 16 Pages, 19 Figures, 14 Tables, and 2 Appendices.

Saunders, M. W. and G. A. McFarlane. 1997. Pacific hake stock assessment for 1997 and recommended yield options for 1998. G97-6: 7 Pages, 5 Figures, and 3 Tables.

Saunders, M. W and W. Andrews. 1997. Walleye pollock stock assessment for 1997 and recommended yield options for 1998. G97-7: 10 Pages and 1 Figure.

Richards, L. J., N. Olsen, J. Schnute, and R. Haigh. 1997. Slope rockfish stock assessment for the West Coast of Canada in 1997 and Recommended Yield Options for 1998. G97-8: 21 Pages, 20 Tables, and 16 Figures.

Stanley, R., and V. Haist. 1997. Shelf rockfish stock assessment for 1997 and recommended yield options for 1998. G97-9: 30 Pages, 27 Figures, and 23 Tables.

Yamanaka, K. L. and A. R. Kronlund. 1997. Inshore rockfish stock assessment for the West Coast of Canada in 1997 and recommended yield options for 1998. G97-10: 17 Pages, 1 Figure, and 21 Tables.

Yamanaka, K. L. and A. R. Kronlund. 1997. Analysis of longline logbook data for the west coast Vancouver Island Yelloweye Rockfish Fishery. G97-11: 22 Pages & 19 Figures.

Kronlund, A. R. 1997. A discussion paper on reconciling assessment and management of Inshore Rockfish. G97-12: 67 Pages.

Kronlund, A.R., and K. L. Yamanaka. 1997. Analysis of Zn Hook and Line Logbook Data: Strait of Georgia Management Region. G97-13: 23 Pages, 8 Tables, and 11 Figures.

Walters, C.J., and R. Bonfil. 1997. Multispecies Spatial Assessment Models for the B.C. Trawl Fishery. G97-14: 31 Pages, 12 Figures, and 7 Tables.

Hay, D. 1997. Fraser River Eulachon Assessment. G97-13: 21 Pages, 1 Appendix, 7 Figures, & 9 Tables.

3. Overview of Current Stock Conditions

PSARC Groundfish Subcommittee overviews on current condition of groundfish species

or species groups.

Species or Species Group	Current Stock Condition
Pacific Cod	Unknown
Sablefish	Average
Offshore Lingcod	Average to Low
Strait of Georgia Lingcod	Very Low
Offshore Pacific Hake	Average
Strait of Georgia Pacific Hake	Average
Slope Rockfish	Low to Average*
Shelf Rockfish	Low to Average*
Inshore Rockfish	Low to Average*
Walleye Pollock	Low to Average*
Spiny Dogfish	Average
Petrale Sole	Very Low
Rock Sole, English Sole, Dover Sole	Average to High

* depending on specific stock.

4. Yield Options

In the past a number of categories of yield options have been presented, all of which may not be appropriate for a particular species or stock. The five yield options are: (i) zero yield; (ii) low risk yield; (iii) sustainable yield; (iv) high risk yield; (v) unrestricted yield. These levels of risk are qualitative in that they incorporate neither a formal calculation of probability, nor a precise definition of consequence. Rather, they attempt to convey the degree of uncertainty associated with various yield options. For a detailed description of yield options see Stocker (1994).

Assessment biologists are investigating the quantification of the risks associated with various yield options. An example of "risk" assessment in the context of an age-structured assessment model is reported in the stock assessment for Slope Rockfish this year (G97-8). Risk is a joint function of the probability of particular outcomes or stock conditions associated with a management action, and the consequences of the outcomes. For stock assessments, biologists are attempting to estimate the probabilities of various outcomes, rather than the broader consequences to the fishery. This process may involve an analysis of the sensitivity of recommended yields to uncertainty in the input data and the models which describe population dynamics, and estimation of the probability of particular outcomes associated with choices of model parameters. The Slope Rockfish assessment contains a number of improvements related to this issue.

The Subcommittee emphasized that for some stocks and fisheries, such as inshore rockfish, the biology of the species makes the present approaches to assessment and management inappropriate. Even with significantly greater resources it will remain

impossible to provide advice to ensure sustainability with present approaches to estimating abundances and quota management.

5. Major Subcommittee Concerns

The Subcommittee is concerned about the declining utility of catch per unit effort as an index of stock abundance, and about the lack of adequate catch sampling information (size, age, etc.). This problem is being compounded as new management actions such as individual vessel quotas (IVQs) come into force. The Subcommittee is concerned that there may be no basis for advice on the status of some stocks in the future in the absence of fishery-independent abundance indices such as surveys, tag-recapture studies, or programs that index abundance over time using catch and effort data for selected fishermen, and improved sampling information such as is obtained from port and observer sampling programs.

6. Summaries of Assessments, Reviewers' Comments and Subcommittee Discussions

G97-2 Offshore Lingcod. Leaman and McFarlane.

Accepted Subject to Revision

Offshore lingcod stocks were examined for the northwest and southwest coasts of Vancouver Island, Queen Charlotte Sound, Hecate Strait and the west coast of the Queen Charlotte Islands. Interpretation of stock condition relies on recent trends in catch statistics, although a catch-age analysis is conducted for the stock off southwest Vancouver Island Off the southwest coast of Vancouver Island (Area 3C), CPUE has declined in recent years from the historic high in 1993 and is well below the long term average. Catch-age analysis suggests declining biomass, low recruitment and the need for a conservative harvest regime. CPUE off northwest Vancouver Island (Area 3D) suggests stock abundance is declining. Recent declines in CPUE in Queen Charlotte Sound (Areas 5A-5B) may indicate stocks are below the long-term average abundance level. Recommended yield levels range from 950 t, 400-800 t, and 1100-2200 t for Areas 3C, 3D, and 5A-B, respectively. The fishery in Hecate Strait (Area 5C-D) has recently undergone a dramatic increase in effort, but there is little biological information available to guide yield recommendations. A recommended yield level of 1000 t is provided out of concern for the sensitivity of the species to exploitation and the rapid expansion of the fishery.

Reviewers' Comments

Reviewer #1

The reviewer was generally complimentary, and noted that a general concern for the Area 3C assessment is the very low catch sampling rate used to estimate the catch age

composition over the 20 year history of the assessment. Of these samples, 5 years have only 1 sample and 3 of those were in the last 5 years of the series, and it is unlikely that such a low sampling effort can track year-classes through the fishery. The low sampling rate may explain the high variability in recruitment estimates in the final years of the stock synthesis analysis. The reviewer recommended that increased sampling, possibly through the fisheries observer program, should be implemented.

The reviewer suggested that it might be useful to investigate age-aggregated production analyses for lingcod. Although age composition data are available only for Area 3C, all areas have long time series of catch and effort data which are well suited for production modeling.

Some additional information on the stock synthesis analysis of the Area 3C lingcod was requested, to provide a complete description of how the calibration indices were calculated and a description of diagnostic plots used. The reviewer also recommended that the authors should more fully describe the criteria used to choose the "best" model runs, and that little is presented on assessment uncertainties. He endorsed the authors' suggestion that additional work on uncertainties should be included in future assessments.

Reviewer #2

The reviewer also was generally supportive of the analysis, and criticisms were largely related to details of the catch-at-age (CAA) model applied to the Area 3C stock, and supporting graphical and tabular presentation. However, the reviewer believed that resolution of these issues was unlikely to change the overall trajectory of the Area 3C lingcod stock and the conclusions drawn in the paper. The erosion of the biological data on which the analysis was based (attributable to changing management tactics and the multi-species nature of the fishery) was raised as a source of concern—a recurring issue during the meeting for other stocks as well. The reviewer commented that assessment of stocks based only on qualified CPUE data is difficult given the general decrease in qualified landings. This trend, in addition to concerns expressed by the author over localized depletion, highlight changes in fishing behavior which may compromise the index. In particular, the paucity of data for Area 5E suggests that the data are non-informative about stock status rather than showing no indication of stock decline.

The reviewer also identified several technical details concerning the analysis that needed further review in future, including assessment of the weight applied to age samples and the comparison of objective values for determining the appropriate formulation of selectivity. In addition, the erratic behavior of the recruitment trajectories in the latter portion of the time series needed to be diagnosed, and clarification of the parameterization of recruitment in the model and forward projections needed to be provided.

Subcommittee Discussion

For the 3C catch at age analysis it was suggested that use of an asymptotic selectivity

relationship would be more appropriate as this would be more conservative and would reduce the number of parameters to be fitted by the model. Oscillations in recruitment estimates between 0 and some value in successive years were thought to be due to model problems and several suggestions were made for dealing with these.

For areas 3D, 5A/B, 5C/D and 5E the Subcommittee noted that both catches and effort had been down in 1996 and was advised that these declined further in 1997. These declines may have been due to changes in fishing patterns, as trawl CPUE increased in 1996 and there have been no sustained trends in CPUE over the past 6-7 years. Accordingly the recommendation to maintain previously advised yield levels seemed appropriate. The Subcommittee and Reviewer #2 recommended that hook and line CPUE be examined in future assessments since catches from this gear type were significant in some areas.

The Subcommittee accepted the assessment paper and the yield recommendations. Authors were requested to revise the paper in line with reviewers' comments. For Area 3C the authors are to consider the effects of using an asymptotic selectivity function on stock reconstructions and yield projections instead of using the curved function used in the paper. The authors will also look for ways to diagnose the cause of the oscillations in recruitment estimates evident in the analysis by, for example, using average recruitment throughout instead of estimating recruitment, and by doing model runs without aging error.

G97-3 Pacific Cod: Haist and Fournier. **Accepted Subject to Revision**

This PSARC document presents stock reconstructions and stock projections, based on catch-at-length analysis, for the Hecate Strait Pacific cod stock. The analytical model is modified from that used for previous assessments to account for changes in the mesh size regulation for the Hecate Strait trawl fishery. No analyses are conducted for Pacific cod on the west coast of Vancouver Island because of a lack of biological samples from this stock in recent years.

Assessment results indicate that there is conflicting information in the 1997 CPUE and length-frequency data regarding recent recruitment levels for the Hecate Strait stock. The CPUE data indicate a significant increase in stock abundance in 1997, but there are no signs of recent recruitment in the length frequency data. The base case stock reconstruction suggests that the Hecate Strait Pacific cod stock is now at a historic low level. Alternate analyses, with lower weighting on the 1997 length frequency data, are less pessimistic and suggests that stock abundance is increasing (Fig. 1). There is no objective basis on which to decide if either the CPUE or the length frequency data is biased.

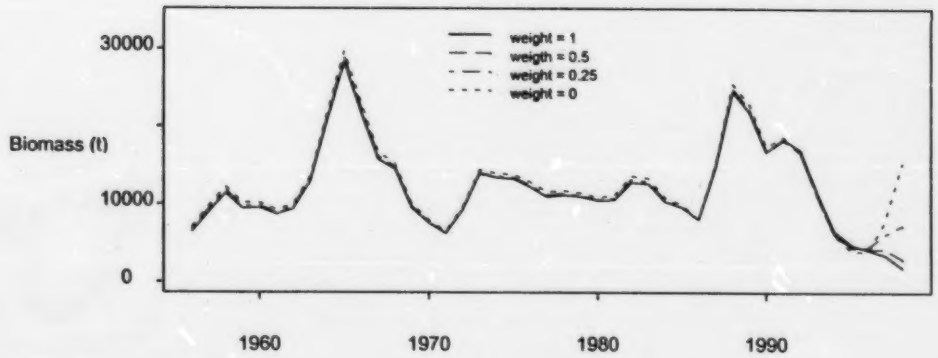


Fig. 1. Spawning stock biomass estimates for Hecate Strait Pacific cod. The lines show results from analyses with alternative weightings on the 1997 length-frequency data.

Reviewers' Comments

Reviewer #1

The reviewer felt that the model framework used in this analysis is the best available and that the problems and uncertainty in this analysis are problems of interpretation rather than model choice. However, he noted that these results were confounded by the choice of which time periods in which it was assumed that the selectivity of the fishery and catchability of the gear was constant.

The reviewer also noted that the number of biological samples on which the analysis was based was very small and that this was of concern—a recurring comment during the meeting for other fisheries as well. He also noted that the assessment was "bedeviled" by the lack of any fishery-independent data sources at a time that trip limits and IVQ's have dramatically modified the behaviour of the fishing fleet. He noted that the authors of the assessment had pointed out that there was no objective basis for determining if the downward trend in recruitment from the length-frequency data was due to changes in fisheries targeting, or if the changes had been induced by changes in fleet behaviour.

Reviewer #2

The reviewer concluded that the assessment was reasonable given the current difficulties in assessing this stock. He suggested the document would benefit from improved descriptions of the choice of some parameters used in the model; specifically estimates of M, the length/age conversion, and a more detailed discussion of the estimates of bias. He also indicated that a more detailed presentation of recommendations and yield options was warranted.

The reviewer felt this assessment highlighted an important issue for groundfish. Given current data and current assessment techniques, we are not able to adequately assess many stocks and develop yield recommendations with any degree of certainty. For

Pacific cod we have a database which is more complete than most, we are using "state of the art" assessment techniques, and yet we have two analyses which give conflicting views of current stock size and trend and no "objective way" of deciding which is closer to reality. The reviewer suggested that we should be directing more effort at the role of climate ocean conditions in determining productivity of fish in order to understand these linkages and the underlying mechanisms. This will improve our understanding of what "productivity" regime we are working in.

The reviewer emphasized that there is growing support for the "regime" concept in relation to ocean productivity/fish abundance trends. If valid, the regime concept places emphasis on the current dynamics of the ecosystems (i.e. within the current regime), particularly with respect to estimates of mortality and recruitment. This also means the "dynamics" in past regimes might be less influential when developing current (and future) quotas. For some stocks, recruitment appears to have fluctuated independent of stock size, at least over the observed range of biomass levels. This is clear evidence that we need to emphasize the role of climate/ocean productivity when providing advice to managers.

Subcommittee Discussion

The Subcommittee expressed concern over the low level of biological sampling and lack of fishery independent data with which to assess this stock. The Subcommittee suggested that fishery observers be used to obtain biological samples of this species from the fishery. The Subcommittee expressed concern about the possibility of recruitment overfishing of this stock and the lack of prior information on recruitment for this stock. They recommended that the effect of environment on this species' recruitment be incorporated into future assessments. The Subcommittee recommended that the policy of not permitting a directed fishery be continued, but that incidental landings from this stock be allowed.

G97-4 Flatfish. Fargo. ** Accepted Subject to Revision**

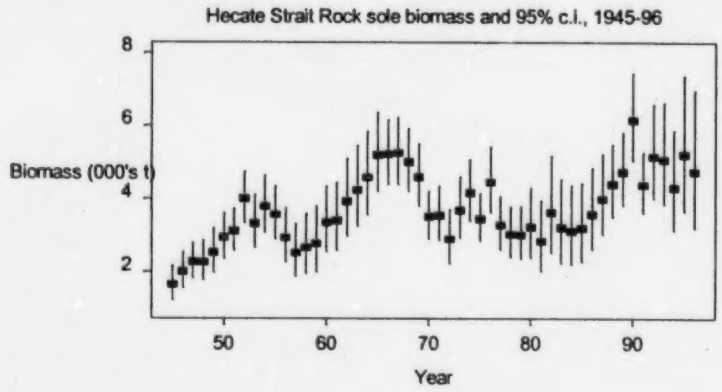
Interim assessments were prepared for important stocks of flatfish caught in the B.C. trawl fishery. In the past, CPUE from the commercial trawl fishery has been used as a surrogate for stock abundance for the assessments for Area 5A-B rock sole and Area 3C-D and 5C-E Dover sole. However, the behaviour of the fishing fleet has been dramatically altered by changing trip limits and other regulatory measures in recent years and CPUE can no longer be considered a reliable index of relative abundance. Only summaries of the landing statistics are presented for the stocks listed above. Until more comprehensive assessments for these stocks are undertaken the yield options will remain the same as those recommended for the 1997 fishery. The assessments for Area 5C-D rock sole and English sole stocks are based on catch-age analysis and include biological samples collected during the 1996 fishery.

Petrale sole

Petrale sole stocks are at low abundance. Landings of Petrale sole from Area 3C and 3D in 1996 were 54% and 80% below the long term mean for 1944-96, respectively. In 1997 managers imposed a coastwide landings cap of 400 t to prevent overfishing of these stocks. This regulation has reduced fishing effort on these stocks substantially. The effect of lower fishing effort on stock abundance cannot be assessed for several years.

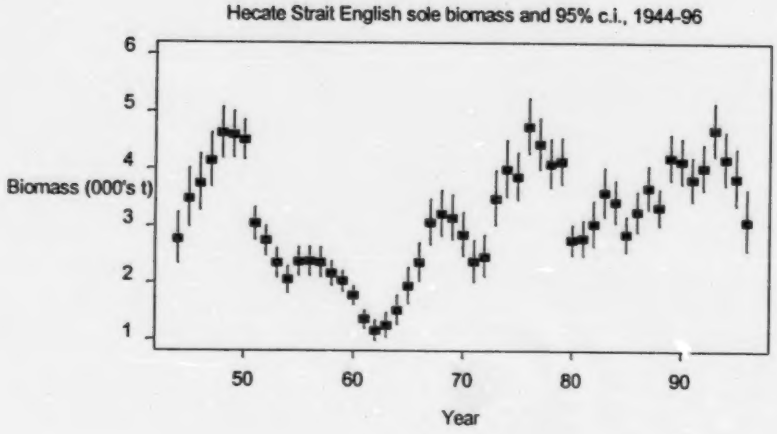
Rock sole

Landings of rock sole from Area 5A in 1996 were 56% below the long term mean for 1954-96 while effort in 1996 was 16% below the long term mean. Landings of rock sole from Area 5B in 1996 were 33% below the long term mean for 1954-96 while effort in 1996 was 30% above the long term mean. Area 5C-D rock sole biomass in 1996 estimated from catch-age analysis was above the long term average for the last 50 years. The estimate of fishing mortality for the stock in 1996 was below $F_{0.1}$. The yield recommendations for this stock in 1998 are unchanged from those recommended for 1997.



English sole

Biomass for Area 5C-D English sole in 1996 estimated from catch-age analysis was slightly above the long term average for the last 50 years. The estimate of fishing mortality for the stock in 1996 was below $F_{0.1}$ and fishing effort on this stock in 1996 was low, partly the result of the area closure for Pacific cod. This area closure included a significant amount of habitat occupied by English sole as well. The yield recommendations for this stock for 1998 remain the same as those recommended for 1997.



Dover sole

Landings of Dover sole from Area 3CD in 1996 were 13% above the long term mean for the 1988-96 period while effort in 1996 was 28% above the long term mean. Landings of Dover sole from Areas 5C-E in 1996 were 30% above long term mean for the 1970-96 while effort in 1996 was 83% above the long term mean.

Reviewer's Comments

The reviewer felt that the author had done a good job of trying to summarize a large amount of material for several species in a multitude of management areas. However, he also felt that the paper should be able to be assessed without reference to other documents, and should contain much greater detail on the background of the assessments (including data and analytical procedures) than was presented. The current interim assessment document included no explanation of how any of the basic data such as CPUE were derived and limited presentation of the methods used and the assumptions involved in the assessment, which makes it difficult to evaluate the conclusions drawn by the author.

A general comment was made that, except where catch-age analyses were conducted, the data and methods presented appear inadequate to support the conclusions. However, little more than catch and CPUE information is available for most of the species and stocks examined, and the reviewer felt that as much as possible had been done with the available data. However, he also noted that it was difficult to reach conclusions about the current status or trend of a stock based on changes in CPUE over the past few years. The reviewer suggested that it would be useful to estimate total mortality from the age structure information in all cases where this was possible, in order to provide a rough idea of the exploitation rates on these stocks relative to what they might be able to sustain.

The reviewer concluded that the advice presented makes a good first step towards trying to deal with the uncertainty in the data and analysis by providing alternative yield options

based on the variation in the estimate of current abundance levels. A concern was raised about the yield options presented for small stocks, in that the difference in yield between the low and high risk options was only on the order of a few hundred tonnes. For most stocks the available data was so limited that the reviewer felt that it was unlikely that abundance could be estimated accurately enough that it would be possible to detect what impacts these alternative management tactics might have on the stock.

Subcommittee Discussion

Subcommittee discussion ranged over the applicability of catch-age and surplus production models to the various flatfish stocks. Surplus production analysis is not applied to west coast Vancouver Island Dover sole because only seven years of good data are available. This model cannot be applied to rock sole in Queen Charlotte Sound because of their extreme variability in recruitment.

It was suggested that the CPUE evidence for declines in Area 5A/5B rock sole was not sufficient to warrant reductions in yield recommendations, in the face of management changes and uncertainty. The adoption of a larger mesh size in Queen Charlotte Sound may have affected selectivity and could contribute to a decline in CPUE. In addition, changes in management regulations have truncated effort and hence landings in Areas 5A and 5B. However, it was noted that the high risk yield recommendation of 500 tonnes in Area 5A was essentially the historic high annual landing. It was pointed out that estimates of rock sole recruitment presented in the paper indicate two highs in the last five years. However, these highs are likely to diminish in relative magnitude as data on the year classes accumulate. The general issue of erosion of CPUE indices by changing management tactics was noted.

The Subcommittee requested the inclusion of additional material where appropriate to create a more "stand-alone" document. In particular, some discussion of the effects of management regulations on declines in abundance indices should be added. Technical appendices describing the catch-age model (Hecate Strait rock and English soles) and surplus-production model (Area 5C-5E Dover sole) are to be included. Finally, research survey CPUE used for tuning the catch-age analysis should be presented in the revised document.

The Subcommittee did not endorse reductions in the 1998 yield recommendations for rock sole in Areas 5A/5B, but noted the low CPUE value for 1996 and decline in recruitment suggested by ageing data. The Subcommittee further recommended that a full assessment for 5A/5B rock sole be completed for the next assessment cycle.

G97-5 Sablefish. Haist, Saunders, Hilborn and Maunder. **Accepted**

This paper represents a major assessment for sablefish. Two stock assessment models are developed for the analysis of B.C. sablefish fisheries and research data. The first is a mark-recapture model that explicitly accounts for fish movement between both spatial and depth strata. The second is an integrated catch-age mark-recapture model where only

movement out of the assessment region is modelled. The two analytical methods employ some different assumptions and hence allow for alternate fits to the data observations. Separate analyses are conducted for northern and southern areas of the B.C. coast due to observed differences in age and length compositions, growth and evidence from juvenile tagging that recruitment to the areas are drawn from different origins.

Estimates of the 1996 exploitation rates from the two assessment models are not substantially different but the estimated trends in abundance from 1991 to 1996 differ significantly. For the southern B.C. stock the estimated 1996 exploitation rate is 0.056 from the integrated model and 0.05 (range of 0.04 - 0.07) from the mark-recapture model. For the northern B.C. stock the estimates are 0.18 and 0.11 (range of 0.09 — 0.15) from the integrated model and mark-recapture model, respectively. The mark-recapture model analyses suggest significant declines in stock abundance between 1991 and 1996 for both stocks. The stock reconstructions from the integrated model indicate relatively stable abundance for the southern stock and only a slight decline in abundance for the northern stock over the same period (Fig. 2).

Potential yields are calculated based on stock projections from the integrated model analyses. Yield calculations indicate that relatively stable stock sizes can be maintained at yields from 2310-3180 t for the south and 1150-1590 t for the north (3460-4770 t coastwide).

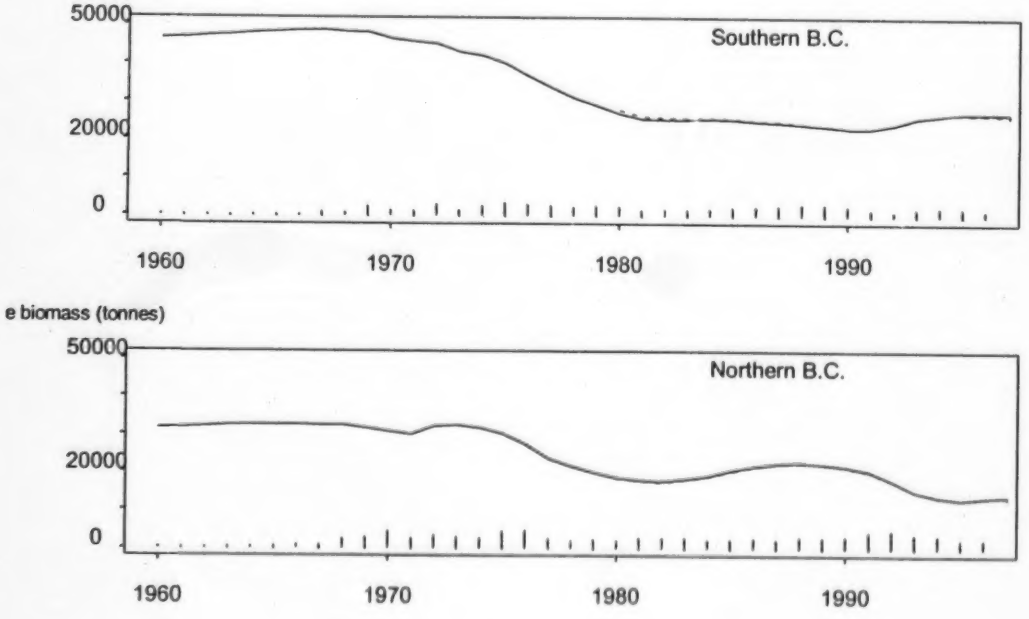


Fig. 2. Estimates of exploitable biomass from runs using catch data for 1960-1997 (solid lines) and catch data for 1980-1997 (dash line). Annual catches are shown with vertical bars.

Reviewers' Comments

Reviewer #1

The reviewer felt that the assessment reflected a steady improvement in the sablefish database and the development of an advanced assessment model that took full advantage of these data. The reviewer also noted, however, that application of the integrated model did not result in a fully satisfactory assessment. There were unexpected values for some parameters, differences in model behaviour between north and south areas, and the trend in estimated abundances was not consistent with the observed downtrend in the trap fishery CPUE or in the trap survey CPUE. In his view the observation that the mark-recapture model and the integrated model produced similar estimates of recent abundance and exploitation rate was insufficient to overweigh these concerns.

The reviewer recommended that a high level of caution be used in employing the base model runs as the strict basis for management, particularly because of the downtrend in the southern region CPUE that was observed and the downtrend found in the 1997 US West Coast sablefish assessment. Forecasts in the northern region suggest that catch needs to decrease to the lowest level since 1980, even though trap CPUE has been stable since 1994.

The reviewer suggested that some areas for potential improvement in the integrated model included the explicit consideration of sablefish migration between depth strata, and consideration of the possibility that some tag-model parameters change with depth or age.

Reviewer #2

The reviewer commented that the paper did a good job of conceptually integrating the current tag data, survey data, and commercial fishery data into an integrated framework to estimate biomass and exploitation rates. The reviewer also agreed with the authors that the integrated model results were inconsistent with declining trends in CPUE data for both the commercial and the research surveys, and that the present formulation of the model does not provide an adequate representation of sablefish stock dynamics. The inconsistencies between the data and the model implies that the assumptions of the model have not been met. The reviewer concluded that "Despite attempts to provide yield options based on a range of target fishing mortality rates, using point estimates of biomass estimated from base case runs to project yield options for 1998 could be viewed as not sufficiently precautionary".

Subcommittee Discussion

There was extensive discussion among the Subcommittee regarding results from the two models that were used to describe sablefish abundance. The Subcommittee expressed concern about the discrepancy in results from the mark-recapture model and those from an integrated catch-age recapture model. The former indicated that a significant decline

in abundance has occurred in recent years while the latter indicated a relatively stable abundance over the same period. The Subcommittee noted the tag shedding-mortality-migration enigma apparent in both models and how it would affect model projections, and that information on migration between depths should be incorporated into the current analysis. It also noted that the abundance trend from this model did not agree with the trend in CPUE from the fishery or from surveys.

The Subcommittee agreed with the authors and reviewers that further development work is necessary to resolve the inconsistency in results between the two models but questioned whether the input data contained enough information to warrant more model tuning. It expressed concern that the model stock trajectory was erroneous since the tagging data and survey data indicate that the population is declining. The Subcommittee also questioned whether the use of the base case model run should be used for management. The authors noted that a conservative harvest rate was being applied to the model estimate of biomass to protect against overfishing. In addition the authors indicated that there are many refuge areas where sablefish are not being fished that contribute to recruitment for these stocks. The reviewers and the Subcommittee concurred that the current models do not adequately capture sablefish dynamics and that future simulation work could be made more biologically meaningful.

It was suggested that the authors look at fishery data from the 1980s in order to establish what the maturity schedule was for earlier periods and update the spawner per recruit analysis. The Subcommittee **recommends** that authors look at these data and incorporate them in time for next year's analysis.

G97-6 Strait of Georgia Hake. Saunders and McFarlane.

Accepted Subject to Revision

The catch in the 1996 Strait of Georgia fishery decreased to 10,185 t from 11,859 t in 1995. Age and growth data continue to indicate strong recruitment during the 1990s and a coincidental decline in the mean size-at-age. Hydroacoustic surveys conducted during 1996 and 1997 found 57,258 t and 41,964 t, respectively. A major assessment is required to draw the surveys and updated biological data into an appropriate modelling framework. In the interim we have applied low-high risk annual rates of fishing mortality generated for the offshore (west coast of Vancouver Island) stock to the current estimate of exploitable biomass for the Strait of Georgia stock (41,964 t). The resulting range in yield is 7,554-14,687 t.

Reviewers' Comments

Both reviewers expressed concern with the reported biomass drop by about 25% from 1996 to 1997. Apparently, this has occurred in spite of strong year classes (ages 2, 5, and 6) still present in the 1997 biomass. The authors felt that environmental effects may be possible explanators, as evidenced by the decrease in size at age since 1993. A reviewer pointed out that the size decrease might also be explained by density dependence associated with high recruitment.

Subcommittee Discussion

The Subcommittee and reviewers noted that the suggested yields seemed high, relative to current biomass levels described in the report. After some discussion, it was discovered that the yields listed in Table 6.3 included stock size estimates for the west coast population of Pacific hake. The authors agreed to remove this table in order to reflect the proportion of hake stock relevant to this report. Given that change, the Subcommittee agreed to adopt this interim assessment.

G97-7 Walleye Pollock. Saunders and Andrews.

Accepted Subject to Revision

The catch of walleye pollock declined in all areas but the west coast Vancouver Island where catch increased substantially as a result of the recruiting 1994 year-class. Overall, the coastwide catch increased slightly to 4512 t in 1996 from 4265 t in 1995. No new analyses have been conducted and the yield options remain unchanged from the previous assessment. The range of sustainable yield options based on Gulland's (1983) MSY model is 470 to 1760 t for the Strait of Georgia (excluding Area 12) and 330 to 1320 t for Dixon Entrance/Hecate Strait. A precautionary quota of 1000-2584 t is recommended to cap the yield in Queen Charlotte Strait (Minor Area 12) until a detailed assessment can be conducted. Yield options are not proposed for stocks off the west coast of Vancouver Island.

Reviewer's Comments

The reviewer noted that the current status update is very similar to the fishery update in 1996 (G96-8) that was previously approved by PSARC, and that the yield advice for 1998 is the same as for 1997, and there has not been a major assessment of this species since 1991. The reviewer noted that the Subcommittee had previously commented (Advisory Doc. 96-4) that there were insufficient resources to collect the necessary data for an assessment. As a result, it is not possible to determine from this document whether the suggested yields are likely to be sustainable and it is not clear that the results of a 1991 assessment continue to hold in 1997. He suggested that assessments of ecologically related species might offer some guidance on the status of pollock, in the absence of new data.

Subcommittee Discussion

The Subcommittee notes the lack of current information with which to derive current stock assessment estimates. The document was accepted without comment. The Subcommittee also **recommends** that in future further papers should not be submitted until a major assessment is completed.

G97-8 Slope Rockfish Status: Richards, Olsen, Schnute and Haigh.
Accepted Subject to Revision

This document represents an interim update of last year's major assessment of the stock status for slope rockfish. For assessment purposes, these include Pacific ocean perch, redstripe rockfish, yellowmouth rockfish, rougheye rockfish, shortraker rockfish, and shortspine and longspine thornyheads. Major additions to this document from the 1996 assessment include (1) simulation studies to evaluate alternative harvest strategies for Goose Island Gully Pacific ocean perch, (2) results from a 1996 survey off the west coast of Vancouver Island, (3) preliminary results from a 1996 survey in the experimental area north of 54°, (4) preliminary results from a 1997 survey off the west coast of the Queen Charlotte Islands, (5) an overview of multispecies information from the 1996 observer data, and (6) yield recommendations by major area for most species.

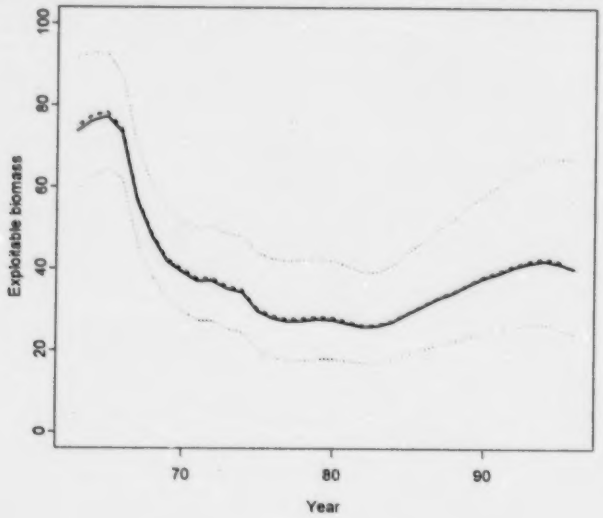


Fig. 3. *Exploitable biomass trajectory and 95% confidence interval estimated from model runs. The center dashed line shows the results of the model run presented in Richards and Olsen (1996).*

The best information pertains to the Goose Island Gully stock of Pacific Ocean perch. An age-structured analysis for this stock uses catch-age data available from 1963-96 and a series of trawl surveys, updated with recent surveys in 1994 and 1995. Based on this analysis, the foreign fishery of the late 1960s and early 1970s reduced the stock to about a third of the 1965 exploitable biomass by 1977 (Fig. 3). Between 1977-84, biomass remained relatively constant. Exploitable biomass then increased to more than half of the 1965 level by 1994, as a result of above-average recruitment and low fishing mortality rates. Point estimates of beginning of year biomass decreased slightly between 1994-97. Biomass is likely to decrease again for 1998, given the absence of incoming above average year-classes. However, biomass is anticipated to remain near the expected long-term average biomass. Rigorous simulation studies (item 1 above) have improved the risk

analysis from earlier assessments. Following precautionary principles, a projected future stock biomass is compared with a historically low biomass, in this case the biomass in 1977. The historical estimate is not known precisely, and future projections contain uncertainties from both the past and the future.

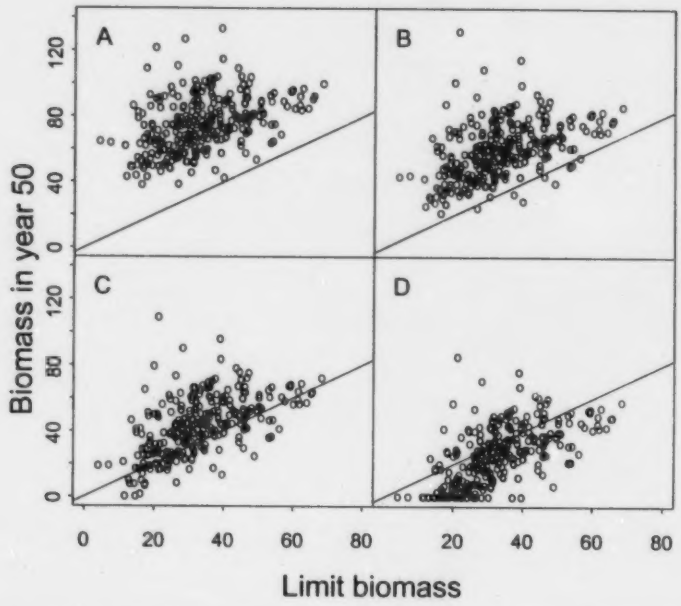


Fig. 4 *Projected biomass 50 years in the future (1000 tonnes) related to historical estimates of 1977 biomass under catch policies of (A) no fishing, (B) 1,000 tonnes, (C) 2,000 tonnes, and (D) 3,000 tonnes. The solid line identifies the condition where the projected future biomass the estimated 1977 biomass.*

Fig. 4 compares predictions (vertical axis) with past estimates (horizontal axis) under four policies of constant catch. Each scatter plot represents uncertainties in both quantities. Risk can be quantified by the proportion of points below the 45° line, where the future projection is lower than the historical biomass. Risk increases with higher catches, as summarized in Table A (below). Thus, yield recommendations can be linked directly to the risk policy.

Because of limited data, we are less certain about the status and potential yields of other stocks of Pacific ocean perch. Based on recent surveys (items 2-4, above), we have recommended decreases in the yields in Areas 3C and 5E-S and an increase in the Area 5E-N yield. We have not recommended changes to the yields in Areas 3D and 5C/D.

Yields for redstripe rockfish, yellowmouth rockfish, and shortspine thornyheads are derived from 25%, 38%, and 12%, respectively, of the Pacific ocean perch yield. These percentages are expanded from Goose Island Gully bottom trawl survey information, after considering potential midwater abundance and recent ratios in the catch. Yields for

rougheye rockfish are based on the species longevity of up to 147 years of age. Yields for shortraker rockfish are determined from the ratio of shortraker to rougheye rockfish in monitored landings. We have no scientific basis for recommending yields for longspine thornyheads.

The observer database, initiated in 1996, has significantly extended the quantity and quality of data available for stock assessment analysis. In particular, this database contains detailed geographic information and species composition of the catch, including discarded catch. An overview of some of this new information (item 5, above) reveals the true multispecies character of the groundfish trawl fishery. The authors anticipate future multispecies models that take advantage of this information, particularly when multiple years of observer data become available.

Table A. The measure of risk (proportion of simulations with biomass 50 years in the future less than the 1977 biomass) as a function of constant catch policy for Goose Island. Yields for Area 5A/B are set 20% greater than corresponding yields for Goose Island Gully.

Catch Policy (tonnes)	Risk
0	0.00
500	0.01
750	0.01
1000	0.03
1250	0.03
1500	0.06
1750	0.14
2000	0.25
2250	0.38
2500	0.52
2750	0.65
3000	0.75
4000	0.97

Reviewers' Comments

Reviewer #1

The reviewer commended the authors on a clear presentation, progress on risk assessment and the timely inclusion of recent survey data. The reviewer expressed concern regarding reliance on absolute abundance estimated from trawl surveys and recommended evaluating the proposed five year rotation for surveys and possibly conducting research to examine factors influencing the variability associated with trawl surveys. It was recommended that catches by species be incorporated in the management history tables. The multispecies overview was a good beginning however a more complete discussion of the potential use of these data in future assessments would

justify the extensive presentation. There was concern raised regarding the impact of autocorrelation within the recruitment times series and the potential impact on the Goose Island Gully Perch stock projections. Given the size of the 5C/5D perch catch, it was recommended this stock be given research priority. There was a request for clarification on the choice of apparently high risk assumptions in the calculation of redstripe and shortraker yield options.

Reviewer #2

The reviewer found the authors' assessment to be very thorough, making the most use of the limited data and information available for slope rockfish, and commended the authors for their development of useful graphical techniques which captured the essential information while remaining clear to visualize.

Reviewer #2 agreed that as sufficient data only exists for Pacific Ocean Perch in Area 5A/B to perform a statistical catch-age analysis, the authors' approach of using estimated yields for this stock to form a recommended yield for several other stocks was logical; however, following discussion at the PSARC meeting where the yield options for Area 5A/B Pacific Ocean perch came into debate, the danger of having inter-dependent yield options became apparent.

Subcommittee Discussion

The Subcommittee noted that the status of the Goose Island Gulley (GIG) stock of Pacific ocean perch was unchanged from last year, but a new framework for developing yield options based on risk analysis was presented. Yield recommendations for a number of other slope rockfish stocks are based on those from the assessment of the GIG stock of Pacific Ocean Perch.

Not all risks are covered by the proposed risk assessment framework; for example, risks associated with the form of the stock-recruitment relationship, environmental change or depensation at low stock levels. It was suggested that risk of going below an arbitrary biomass level over the long term was not the most important risk to be addressed: the question which would be most interesting to fishermen is the probability that the fishery would have to be closed or catches greatly reduced. It was noted that use of a constant catch assumption might overestimate risk since in reality there would be future responses to changes in stock status, and that some more detailed or more realistic future scenarios should ideally be the basis for yield projections. Although no Bayesian priors were specified, uniform priors had been used in doing the simulation runs. The authors and Subcommittee agreed with these comments but noted that this was an initial analysis which could be expanded in future assessments.

Doing simulations over a 50 year period would probably underestimate risk. Simulations covering shorter periods were examined. The risk of going below the limit biomass are a function of the time period over which simulations were run and the catch level. At 0 or low catch levels there is a risk of going below the limit when short periods are simulated because the simulation depends to a large extent on the current biomass level.

The effect of catch underreporting on the assessment of stock status and on risk levels was discussed. It was noted that there could have been substantial underreporting of catch in recent years and that temporal and spatial variations were also probably substantial, although no hard data are available on this. Accounting for underreporting would probably lead to higher recent biomass estimates although the effect is hard to predict until future analyses examine this possibility. Incorporating the best information possible on discarding, even if approximate, would make the assessment results more realistic.

The Subcommittee noted that the risk analysis and yield options depended on two values: a limit reference point (the 1977 biomass estimate, a low point in the time series) and the levels of risk of going below the limit biomass based on a constant catch over a 50-year period. The basis for using the 1977 biomass was questioned as this appeared to be around 35% of historic high biomass levels and this might be considered a very conservative limit. Ideally some biologically based reference point would be used, for example some proportion of mean unfished biomass.

Three yield options at levels of risk of 3%-25% were presented. It was generally agreed that decisions on the levels of risk to be accepted should properly be discussed in another forum including industry and fishery managers. Table A, providing catch levels associated with risk levels, was considered particularly appropriate as a guide for such a discussion.

Ideally, the recruitment numbers used for forward simulations should incorporate information on possible climatic variability leading to different production regimes; this could be incorporated into the framework.

The Subcommittee acknowledged that this was a useful paper which provides an innovative framework for making decisions on harvest levels based on implementation of the precautionary approach and on consideration of uncertainty in biomass estimates. The paper and yield recommendations were accepted, subject to revisions in line with the reviewers' and Subcommittee comments. The Subcommittee recommended that the approach be further developed and recommended that Fisheries Management in consultation with industry develop harvest strategies to provide direction to stock assessment staff about what harvest scenarios be considered in future assessments.

The Subcommittee noted that yield options for Area 5C/D Pacific ocean perch, a stock from which a high proportion of the total coastwide yield is taken, are based on very incomplete information and recommended that measures be taken to improve the information base on this stock.

G97-9 Shelf Rockfish Assessment. Stanley and Haist.

Accepted Subject to Revision

Interim assessments are provided for silvergray, widow and canary rockfish. Recommendations for these species are unchanged from the previous year. The ranges for silvergray rockfish in PMFC Areas 3C+3D (Vancouver Island), 5A+5B (Queen Charlotte Sound), 5C+5D (Hecate Strait) and 5E (west coast Vancouver Island) are 150-425 t, 350-700 t, 125-400 t, and 175-300 t, respectively. Landings in 1996 for the three stocks were 190, 411, 609, and 272 t. Recommended yield ranges for the canary rockfish stocks of Area 3C+3D and Area 5A+5B are unchanged at 350-525 t, and 200-400 t, respectively. Landings for the two stocks were 312 and 131 t. The recommended coast wide yield range for widow rockfish is unchanged at 1,100-3,000 t. Landings were 1,702 t in 1996. Stock status for these three species is poorly known but thought to be poor to average.

The yield recommendation for the coastal yellowtail rockfish stock (Areas 3D-5E) is lowered from 2,750-5,100 t to 2,000-4,025 t. Landings were 4,122 t in 1996. The change in the assessment follows a catch-age analysis which attributes the relative absence of older fish in recent years and the lack of evidence of significant recent recruitment, to a steady decline in abundance. The stock appears to be in a lower than average abundance, mostly owing to poor recent recruitment. The yield recommendation for the yellowtail rockfish stock of PMFC Area 3C fishery (south Vancouver Island) is combined with the northern Washington fishery (Areas 3C-US and 3B). The recommendation is raised from 1,000-2,000 t to 1,100-2,400 t based on a re-assessment of the stock by U.S. biologists. Landings were 4,664 in 1996. The rise in quota reflects a minor change in perception of the current biomass but, managers are advised that the assessments in both years indicated a major decline in the abundance of this stock, and other yellowtail rockfish U.S. stocks to the south. This stock appears to be in a declining phase.

Reviewer's Comments

The reviewer broke his review into sections reflecting the species included in the overall assessment document. Major comments were received on two species; other comments were largely of an editorial nature.

<u>Widow Rockfish</u>

The document has a brief review of historical catch, a table of the biological samples available and a review of recent yield recommendations. The authors assume that reported catch is biased high by about 20%, but provide no evidence to support their perspective. The reviewer noted that as there is no estimate of stock abundance; and that recommended harvest rates appear to be based on historic landed catch, choosing an allowable harvest becomes a pure policy decision. The reviewer felt that given the decline of the resource in two of three significant statistical areas, some reduction in historic harvest levels seems appropriate, and that maintenance of the status quo recommended harvest range may not convey the requisite level of concern managers should have for this stock.

Yellowtail Rockfish ("Coastal" stock)

The reviewer again noted that yield recommendations appeared to be subjective, and that the authors appear unconvinced that their models produce reliable estimates of absolute abundance, but that they can describe the trend in abundance. Recommendations for yield were therefore based on adjustments in historic catch rates commensurate with the change in abundance observed in the model.

The discussion of biological data focused on age data (predominately the weighting of these data in the age-structured assessment, on temporal changes in weight-at-age), and the model treatment of natural mortality and recruitment. The reviewer felt that the author's weighting of age data within the model was appropriate but that definitive studies of alternative weighting mechanisms were lacking.

The reviewer felt that the author's endorsement of a model with two selectivity periods and with forced estimates of 1996 fishing mortality as the "most plausible" was a purely subjective endorsement. He noted that under any of the model configurations presented, stock biomass has declined, but that the magnitude of the decline remains difficult to resolve but that the risk of overfishing could be substantively understated in the current assessment.

Subcommittee Discussion

Subcommittee discussion focused on the issue of whether a catch-age model could provide estimates of abundance in the absence of a tuning index. The existing catch-age analysis is essentially a catch curve analysis that tracks the yellowtail population over time and attempts to explain the disappearance of older fish. The marked change in sex ratio may be driving this model. Differences in size selectivity are not likely to be explained by sampling variability. The trend for smaller size at age was noted

The Subcommittee requested that support for the 3D-5E quota be clarified. Estimates of the confidence bounds on biomass projections should be included in revisions.

G97-10 Inshore rockfish. Yamanaka and Kronlund.

Accepted Subject to Revision

No new analyses are presented in this interim assessment for inshore rockfish. Yields remain unchanged from those recommended in the major review presented in 1996. Data sources for 1996 catch figures have changed from previous years. There remains very conservative estimates of recreational catch and no estimates of aboriginal catch coastwide. Coastwide hook and line catch of inshore rockfish is estimated at 2,041 t from all sources (commercial and recreational). Information from logbook records in the Strait of Georgia show declines in catch per unit of effort indices for quillback rockfish in the three major fishing locations; Lower Gulf Islands, Campbell River and Queen Charlotte Strait. Similar indices for the west coast Vancouver Island show declines for yelloweye

rockfish in Statistical Area 27. The authors noted that "yield recommendations from the major review were rejected when quotas were set for the 1997 fishery", and that in their opinion "current quotas are unacceptable and need to be reduced".

Reviewer's Comments

The reviewer was impressed with the thorough treatment of the available inshore rockfish data, especially given the complexity of the data sources. The reviewer recognized the potential value of a dockside monitoring program but questioned the purpose of the current program in terms of data collected. The suggestion was made that the mandatory logbook and dockside monitoring programs be re-examined and modified to maximize the efficiency of the process and the accuracy of the data collected, and that the data be collected at the spatial scale required to adequately assess inshore rockfish stocks. Clarification of the habitat analysis was requested and suggestions were made for the modification of the format and content of some tables. The reviewer particularly noticed remarks throughout the paper describing symptoms of stock decline and warnings of area depletion and suggested that, if indeed the authors feel that these are important issues, the points should be consolidated and presented in a stronger format.

Subcommittee Discussion

The paper expresses overall concern regarding the current status of inshore rockfish stocks, particularly in the Strait of Georgia. The reviewer and the Subcommittee however, noted that the evidence of decline reported in the paper was limited. Authors reported that based on anecdotal discussions with industry that there are concerns regarding localized depletion. The Subcommittee recognized the difficulty in demonstrating the decline in inshore rockfish stocks and that this problem might be addressed in the long term through approaches proposed in the discussion paper G97-12. However, the Subcommittee felt that it was important to report anecdotal concerns, therefore authors agreed to include it in a discussion of overall stock status.

The Subcommittee recognized that the recommended yields presented in 1996 had not changed and that no assurance of sustainability can be made in regard to these yields. The Subcommittee recommends removing the yield tables and highlighting to managers the possible need for a reduction in current quota levels. It was also recommended that documentation of habitat analysis from the previous document should be carried forward into this document. The paper was accepted pending these revisions.

G97-11 West Coast Vancouver Island Rockfish. Yamanaka and Kronlund.
****Accepted Subject to Revision****

Logbook data from the west coast of Vancouver Island Management Region (Statistical Areas 11, 21 - 27, 111, 121 - 127) longline fishery between 1986 to 1996 are described and trends in catch and effort data are discussed. Catch and effort data recorded on logbooks are recorded on a finer scale than similar data on fish slips. Fishing patterns over the time series have changed with decreasing proportions of yelloweye rockfish in

the catch, an expanded range of mean fishing depths and decreases in soak time and number of hooks fished. Some of these changes can be explained by a shift away from fishing yelloweye rockfish to fishing other rockfish species including quillback, redbanded and rougheye rockfish. This shift in fishing may have resulted directly from changes in the management of the fishery. Analysis of logbook data is preliminary as only half of the records are keypunched for the 1989 to 1992 period. In general, yelloweye rockfish catch (kilograms) per unit of effort (soak time in hours) (CPUE) is declining and quillback and redbanded rockfish CPUEs are increasing. Further analyses for the west coast of Vancouver Island and other management regions of the coast are pending.

Reviewer's Comments

The reviewer stated that the authors provide a clear description of the structure of the logbook database and give an good account of how the management, collection, and processing of the logbook database has evolved since it's inception in 1986. The reviewer recommended that keypunching of remaining historical data be completed as soon as possible in order that current present analyses can be completed.

The reviewer noted that although the authors state that the decline in yelloweye catch and CPUE are probably caused by fishers switching to other rockfish species, they provide no explanation for why this switch occurred. The reviewer felt that the figures are good and supported the author's observation that yelloweye catch and CPUE are declining. He concluded that this was a good first step in the analysis of the Zn logbook data.

Subcommittee Discussion

The Subcommittee accepted the paper with some minor revision and endorsed continuing analysis and collation of Zn logbook data coastwide. The accuracy of these data improves with time and must be carefully analyzed to consider the impact of management actions on the resulting effort distribution. The Subcommittee therefore recommended that future assessments include discussion of the logbook data.

G97-12 A Discussion Paper on Reconciling Management and Assessment of Inshore Rockfishes. ***Accepted Subject to Revision***

An integrated assessment and management strategy for inshore rockfishes (*Sebastes*) has eluded biologists and managers along the west coast of North America. Rockfishes are characterized by longevity, low natural mortality, and restricted mobility of adults relative to the capabilities of fishing fleets. A directed hook and line fishery for inshore rockfishes has become significant in British Columbia since the early 1980s, capitalizing particularly on the lucrative market for live fish.

The primary purpose of this paper is to propose a means of reconciling the difficulties of rockfish assessment with the demands of fishery management. Traditional fisheries models are rendered inadequate by discrepancies among the scales of biological

processes for rockfishes, the activities feasible for assessment, and the pattern of exploitation. Key to this dilemma is a misunderstanding of the planning horizon required to manage populations that may cycle a single generation during the working career of fisheries biologists. Pragmatic simulation modeling is suggested as a basis for resolving the problems of (1) reconciling the time lag between application of a management tactic and realization of its effects, (2) communication among biologists, managers, and stakeholders, and (3) learning about the consequences of experimental manipulation given model assumptions.

The problems associated with assessment and management of inshore rockfish are reviewed. A brief account of the history and current status of the directed hook and line fishery for rockfishes in British Columbia is presented, along with a description of available data. Removals of inshore rockfishes by other fisheries and as incidental catch are outlined. Assessment methods applied to inshore rockfishes along the west coast are reviewed.

Recommendations focus on using simulation modeling to plan large and small scale experimentation designed to learn about (1) harvest driven processes using experimental fishing regimes, and (2) production-driven processes using marine zones, including marine protected areas. The evaluation of stock indices that explicitly incorporate life history (*e.g.* reproductive value) should be conducted in simulation and field research. Additional recommendations are designed to improve the corporate record of management actions and to increase the planning horizon for management. Stakeholder involvement in planning experimentation and ongoing review of objectives is considered key to successful implementation of the simulation results.

Reviewers' Comments

Reviewer #1

The reviewer complimented the author on a thorough and well-laid description of the problems facing the management of inshore rockfish stocks, and concluded that the recommendations in the document form an effective basis for developing an effective integrated strategy for future research and assessment of these rockfish. The reviewer agreed with and emphasized the author's point that in order to develop a strategy and associated tactics for managing inshore rockfish a meaningful set of objectives were needed, and currently do not exist. The reviewer suggested adding a final section to the document setting out a recommendation that some work be initiated to derive a working set of objectives, and thereby identify what information we are lacking to achieve these objectives.

Amongst the key issues identified by the author, the reviewer identified the following major themes as appropriate and needing support:

1. Develop plans for large scale experimentation based on simulation modelling, in order to provide the best vehicle for "integrating management and assessment" which was the purpose of this PSARC assignment.

2. Extend the planning horizon for research and management of rockfishes from an annual activity to a half decade or decade time horizon.
3. Quotas should be set for small regions in order to reduce the risks of hyperstability of catch per unit effort.
4. A corporate record of management strategies and tactics must be established and maintained.
5. Implement a program for systematic sampling of the commercial catch. The reviewer strongly argued that opportunistic sampling of inshore rockfish landings was pointless and wasteful because it has no practical value for studying exploitation. Unless the sampling is being directed on a meaningfully "defined" population (a reef, or associated group of reefs), he stated that sampling should be discontinued.

Reviewer #2

The reviewer complimented the author on a clear summary of the problems that needed to be addressed for inshore rockfish. He indicated that the author had already incorporated many of his detailed comments from a prior review of an earlier draft of the document. The remaining comments were of a general nature, or also were identified in the first review.

Subcommittee Discussion

Subcommittee acknowledges this paper as a valuable contribution to the understanding of the problems faced in the inshore rockfish fishery. The documentation of detailed management actions applied in the fishery since its inception is viewed as the first corporate record compiled and essential to the interpretation of current and future fishery data. The Subcommittee endorses the paper as a basis for future discussion on the directions for research and management. Any movement toward alternative strategies for inshore rockfish assessment and management requires the commitment of all stakeholders to be effective. The bycatch of inshore rockfish in other fisheries is a concern and the Subcommittee recommends that all inshore rockfish removals be identified and quantified.

The Subcommittee recognizes that our ability to assess the status of these stocks continues to be poor but sees the discussion paper as a significant step in providing alternatives. In order to move forward the Subcommittee recommends that a committee be struck comprised of stakeholders, management and PSARC representatives to discuss the assessment and management alternatives and that proposals be rationalized in an overall groundfish research work planning exercise.

G97-13 Strait of Georgia Hook and Line Rockfish Fishery.
Kronlund and Yamanaka. **Accepted Subject to Revision**

Logbook data collected from the directed hook and line fishery for inshore rockfishes in the Strait of Georgia management region were evaluated for their ability to provide assessment information and capture fleet dynamics. Relative to alternative data sources, the structure of logbook data provide improved measures of fishing effort and finer spatial resolution for fishing locations. The impacts of management tactics applied to the fishery since 1986 were considered. In particular, the implementation of limited entry in 1992 divided the catch per unit effort (CPUE) trend for quillback and copper rockfishes into two period of decline. In the absence of fishery-independent indices, the utility of CPUE to index the stocks is thought to be poor given the restricted mobility of adults relative to the capabilities of the fleet (hyperstability of CPUE). Thus, it was concluded that CPUE may serve as a late warning of stock decline rather than a timely indicator.

Time series of catch per unit effort have declined throughout the Strait of Georgia region for quillback and copper rockfishes. In recent years, copper rockfish comprised a greater proportion of the landings in the Gulf Islands (Statistical Areas 17, 18, and 19) than formerly observed. Although the evidence is not conclusive given the available indicators, these analyses are consistent with a decline in the abundance of rockfishes, particularly in the southern Strait of Georgia. Suggestions are provided for future modeling of logbook data to correctly incorporate their longitudinal structure.

Reviewer's Comments

The reviewer found the working paper informative, and that the various data sources were well-summarized and analyzed. She applauded their choice not to use CPUE data as an indiscriminate index of abundance, but noted that in the absence of any other means of indexing abundance in the final analysis the assessment will still depend on CPUE data. She stated that despite funding cutbacks, it was important to develop fishery-independent methods of monitoring abundance.

Subcommittee Discussion

Subcommittee discussion revolved around the likelihood that recent declines in CPUE reflect declines in abundance. The authors agreed to reduce the "requirement" for latitude and longitude to be recorded in logbooks to the highest resolution possible to a "request". The Subcommittee accepted the document with minor revision.

The Subcommittee reiterated concern raised in the previous major assessment that reported the stock condition as poor in the Strait of Georgia, portions of the west coast of Vancouver Island and Queen Charlotte Islands. It recommended caution in setting quotas overall, and in the Strait of Georgia where there was evidence of stock decline, recommended substantial reduction in total removals by all user groups (commercial, recreational and First Nations).

G97-14 Multispecies spatial assessment models. Walters and Bonfil. **Accepted Subject to Revision**

This paper reported progress on a multi-species, multi-ground spatial simulation model for evaluating alternative strategies for maintaining biodiversity and ensure sustainable catches in the B.C. trawl fishery. The fishery is highly concentrated on relatively few fishing grounds, with half the effort occurring on less than 1000 nm^2 of continental shelf and slope area.

The preliminary results from the modeling exercise makes disturbing predictions about side effects of closing particular grounds as marine protected areas, or requiring discard of particular species; such policies were found to have potentially substantial impact on non-target grounds and species due to movement of fishing effort. The simulations suggested that the current coastwide trawl harvest is unlikely to be sustainable for at least some long-lived species, and attempts to set area quotas based on optimum fishing rates for these species could trigger more and more large area closures under the current plan to close areas should any single species quota be exceeded.

Reviewers' Comments

Both reviewers agreed that the extensive analysis in this paper suggests useful avenues for future research using data from the groundfish observer program. The reviewers also agreed that the methods are too new to be evaluated fully in the current PSARC groundfish meeting. As one reviewer put it, "At this stage the only solid conclusion that can be drawn from the results is that the modeling effort is worthwhile."

The modelling framework developed can be used to explore management options for the diverse groundfish stocks. Because of the complex data and model assumptions involved, a consensus emerged that the model could not be evaluated or endorsed at a single meeting. Dr. Walters mentioned, for example, that even he had made new discoveries in the last day or two prior to the meeting suggesting a higher potential harvest rate for one stock.

Subcommittee Comments

Considerable discussion centered around two conflicting problems of fishery management. Scientists and managers seek to detect risk and thus to avoid overexploitation. On the other hand, they also want to detect opportunities for exploiting stocks fully. Quotas might be set low for the first goal, but high for the second. Dr. Walters interpreted Table 9 in his revised addendum from this point of view. He stated that the proposed 1997 DFO quotas represent a reasonable compromise between these goals. In particular, he stated that in his opinion species listed at risk for overfishing are not at risk from the viewpoint of conservation.

The Subcommittee recommended accepting a final revision of the paper that brings various earlier versions into a unified whole. A consensus emerged that the methods offer useful, interesting prospects for future work, possibly in collaboration with the authors.

Tentative results from this paper will at present not be used directly for management purposes.

G97-15 Fraser River Eulachons. Hay. **Accepted Subject to Revision**

A small (20-50 tonnes) commercial fishery for eulachons in the Fraser River was closed in 1994 because of the apparently low abundance of the fish. This paper reported initial progress in assessing eulachon abundance in the Fraser River on the basis of in-river egg and larval surveys. Eggs and larvae were found at all sampling locations, but areas of high density differed between 1995 and 1996. Various estimates of the spawning biomass were possible, ranging from 100-200 tonnes in 1995 to a much higher (but suspect) biomass estimate of 1,000 tonnes in 1996. The author reported that the reliability of these estimates was dependent upon technical issues which have not been resolved.

Reviewers' Comments

Review #1

The reviewer felt that the paper provided a good description of what was done, and further felt that the employment of 3 different statistical analyses was useful. The reviewer suggested that the paper needed a clearer statement of the objectives, and that it would be useful to have a summary of what the commercial fishery catches would tell about the status of the stock.

Review #2

The second reviewer felt that assessment methods should focus on the use of the bootstrapping procedure, and that assessments should all be based on this method as the most robust and defensible method of analysis.

Subcommittee Discussion

This paper represents one of the first attempts to assess eulachon biomass. The concern arose when the stocks of Fraser and Columbia River stocks dropped precipitously in 1993. There has been a request to determine the biomass of the Fraser stock, and to assess whether the observed catches were likely to significantly impact the stocks.

The Subcommittee accepted the paper subject to revision, and noted that the paper represented a significant advance in improving the knowledge base for eulachon assessment. The Subcommittee endorsed the general methodology however, owing to uncertainties regarding the extent of variation among years and the difficulty in rationalizing among estimates for different areas, the Subcommittee **recommended** that additional exploration of the methodology in future years was required prior to accepting the methodology for routine biomass assessment and as a basis for making yield recommendations.

7. Additional Subcommittee Discussions

The Subcommittee **recommends** that a Fisheries Oceanography *Working Group* be struck to collate and present an annual report on "State of the Ocean", given the recognition that ocean conditions and climatic change are important to fish populations. This *Working Group* should initially be modelled after the East Coast Fisheries Oceanography Committee. Membership should include scientists from both the oceanographic and fisheries science sectors. The Groundfish Subcommittee notes that this is a restatement of last year's recommendation, which read in part: ***"Ocean changes can have important impacts on the dynamics of Groundfish populations. Effective management needs to be able to separate natural changes from fishing effects. Both interannual and decadal scale information on ocean and climate changes is needed to assist in the interpretation of stock abundance fluctuations. As this information becomes available it will be used to improve the performance of the stock assessment models."***

Table 1. Summary of recommended yield options for 1996 and 1997, and the new yield options presented for 1998.

AREA	SPECIES	1996 YIELD OPTIONS	1997 YIELD OPTIONS	1998 YIELD OPTIONS
4B	Lingcod	Zero yield (no options proposed)	Zero yield (no options proposed)	Zero yield (no options proposed)
Minor Area 12	Lingcod	No options proposed	No options proposed	No options proposed
3C	Lingcod	Low risk yield 1400 t High risk yield 2800 t	Low risk yield 1400 t High risk yield 2800 t	~~950~~ t
3D	Lingcod	Low risk yield 400 t High risk yield 800 t	Low risk yield 400 t High risk yield 800 t	Low risk yield 400 t High risk yield 800 t
5A/B	Lingcod	Low risk yield 1100 t High risk yield 2200 t	Low risk yield 1100 t High risk yield 2200 t	Low risk yield 1100 t High risk yield 2200 t
5C/D	Lingcod	Low risk yield 1000 t	Low risk yield 1000 t	Low risk yield 1000 t
4B	Pacific cod	No options proposed	No options proposed	No options proposed
3C/D	Pacific cod	Low risk yield no fishery Sustainable yield 694 t High risk yield 916 t	No change in Management Plan	No change
5A/B	Pacific cod	No options proposed	No options	No change
5C/D	Pacific cod	No fishery	No directed fishery	No change
5E	Pacific cod	No options proposed	No options proposed	No change
Coastwide	Petrale sole	No options proposed	No options proposed	No change

AREA	SPECIES	1996 YIELD OPTIONS	1997 YIELD OPTIONS	1998 YIELD OPTIONS
4B	Flatfish	No options proposed	300 t	300 t
3C/D	Dover sole	Low risk yield 1300 t High risk yield 2000 t	Low risk yield 1000 t High risk yield 1500 t	Low risk yield 1000 t High risk yield 1500 t
5A	Rock sole	Low risk yield 250 t High risk yield 500 t	Low risk yield 250 t High risk yield 500 t	Low risk yield 250 t High risk yield 500 t
5B	Rock sole	Low risk yield 250 t High risk yield 600 t	Low risk yield 250 t High risk yield 700 t	Low risk yield 250 t High risk yield 700 t
5C/D	Rock sole	Low risk yield 1200 t (350 t revised 1996) High risk yield 1850 t (700 t revised 1996)	Low risk yield 800 t High risk yield 1100 t	Low risk yield 800 t High risk yield 1100 t
5C/D	English sole	Low risk yield 800 t (300 t revised 1996) High risk yield 1300 t (500 t revised 1996)	Low risk yield 500 t High risk yield 600 t	Low risk yield 500 t High risk yield 600 t
5C-5E	Dover sole	Low risk yield 800 t High risk yield 1200 t	Low risk yield 800 t High risk yield 1200 t	Low risk yield 800 t High risk yield 1200 t
Coastwide	Sablefish	Low risk yield 690 t High risk yield 2580 t	Yield Range: 3,100 - 4,600 t	Yield Range: 3,457 - 4,777 t

AREA	SPECIES	1996 YIELD OPTIONS	1997 YIELD OPTIONS	1998 YIELD OPTIONS
South Stock	Sablefish	Low risk yield 275 t High risk yield 1000 t	Yield Range: S: 1,700 - 2,500 t	Yield Range: S: 2,307 - 3,185 t
North Stock		Low risk yield 465 t High risk yield 1580 t	N: 1,400 - 2,100 t	N: 1,150 - 1,592 t
4B, except MSA 19, 20	Pacific hake	Low risk yield 8000 t High risk yield 14000 t	Low risk yield 10300 t High risk yield 20100 t	Low risk yield 7,554 t High risk yield 14,687t
Coastwide (including U.S. waters)	Spiny dogfish	Low risk yield 9000 t High risk yield 15000 t	Low risk yield 9000 t High risk yield 15000 t	No change
4B (Strait of Georgia)	Spiny dogfish	Low risk yield 4000 t High risk yield 6000 t	Low risk yield 4000 t High risk yield 6000 t	No change
4B	Walleye pollock	Low risk yield 630 t High risk yield 2350 t	Low risk yield 470 t High risk yield 1760 t	Low risk yield 470 t High risk yield 1760 t
5C/D	Walleye pollock	Low risk yield 440 t High risk yield 1760 t	Low risk yield 330 t High risk yield 1320 t	Low risk yield 330 t High risk yield 1320 t
Area 12	Walleye pollock	Low risk yield 1000 t High risk yield 2450 t	Low risk yield 1000 t High risk yield 2580 t	Low risk yield 1000 t High risk yield 2580 t
Coastwide (Area 3C to 5E)	Pacific ocean perch	Low risk yield 3400 t High risk yield 5700 t	Low risk yield 4060 t High risk yield 7210 t	Low risk yield 3330 t High risk yield 7030 t

AREA	SPECIES	1996 YIELD OPTIONS	1997 YIELD OPTIONS	1998 YIELD OPTIONS
5A/B	Pacific ocean perch	Low risk yield 350 t High risk yield 1800 t	Low risk yield 1760 t High risk yield 2340 t	Low risk yield 1200 t High risk yield 2400 t
5C/D	Pacific ocean perch	Low risk yield 1500 t High risk yield 3400 t	Low risk yield 1500 t High risk yield 3400 t	No change
Coastwide (Area 3C to 5E)	Redstripe rockfish	Low risk yield 950 t High risk yield 2570 t	Low risk yield 490 t High risk yield 870 t	Low risk yield 910 t High risk yield 1810 t
Coastwide (Area 3C to 5E)	Yellowmouth rockfish	Low risk yield 1100 t High risk yield 1850 t	Low risk yield 1540 t High risk yield 2740 t	Low risk yield 1380 t High risk yield 2870 t
Coastwide (Area 3C to 5E)	Rougheye rockfish	Low risk yield 500 t High risk yield 900 t	Low risk yield 500 t High risk yield 900 t	Low risk yield 520 t High risk yield 950 t
Area 3C to 5E	Shortraker rockfish	Average of 1993 and 1994 catches	Low risk yield 100 t High risk yield 180 t	Low risk yield 110 t High risk yield 120 t
Area 3C to 5E	Shortspine thornyhead rockfish	Average of 1993 and 1994 catches	Low risk yield 490 t High risk yield 870 t	Low risk yield 490 t High risk yield 870 t
Area 3C to 5E	Longspine thornyhead rockfish	Average of 1993 and 1994 catches	Low risk yield 250 t High risk yield 440 t	Low risk yield 250 t High risk yield 440 t
3B-3C (Combined U.S. and Canadian quota)	Yellowtail rockfish	Low risk yield 1000 t High risk yield 2000 t	Low risk yield 500 t High risk yield 2000 t	Low risk yield 1100 t High risk yield 2400 t
3D-5E	Yellowtail rockfish	Low risk yield 2750 t High risk yield 5100 t	Low risk yield 2750 t High risk yield 5100 t	Low risk yield 2000 t High risk yield 4025 t

AREA	SPECIES	1996 YIELD OPTIONS	1997 YIELD OPTIONS	1998 YIELD OPTIONS
Coastwide	Widow rockfish	Low risk yield 1100 t High risk yield 3000 t	Low risk yield 1100 t High risk yield 3000 t	No change
3C/D	Silvergray rockfish	Low risk yield 150 t High risk yield 425 t	Low risk yield 150 t High risk yield 425 t	No change
5A/B	Silvergray rockfish	Low risk yield 350 t High risk yield 700 t	Low risk yield 350 t High risk yield 700 t	No change
5C/D	Silvergray rockfish	Low risk yield 125 t High risk yield 400 t	Low risk yield 125 t High risk yield 400 t	No change
5E	Silvergray rockfish	No options proposed	Low risk yield 175 t High risk yield 300 t	No change
3C/D	Canary rockfish	Low risk yield 350 t High risk yield 525 t	Low risk yield 350 t High risk yield 525 t	No change
5A/B	Canary rockfish	Low risk yield 200 t High risk yield 400 t	Low risk yield 200 t High risk yield 400 t	No change

Table 2. Recommended yield options for Slope Rockfish, based on the methodology described in PSARC Document G97-8.

Area	Species	1997 Yield Options		1998 Yield Options	
Coastwide (3C-5E)		4060 -	7210	3330 -	7030
3C		250 -	500	80 -	110
3D		100 -	300	100 -	300
5A/B	Pacific ocean perch	1760 -	2340	1200 -	2400
5C/D		1500 -	3400	1500 -	3400
5E-S		300 -	500	170 -	300
5E-N		150 -	170	280 -	520
Coastwide (3C-5E)		1020 -	1800	910 -	1810
3C		N/A		120 -	190
3D		N/A		70 -	150
5A/B	Redstripe rockfish	N/A		370 -	790
5C/D		N/A		190 -	400
5E-S		N/A		140 -	200
5E-N		N/A		20 -	80
Coastwide (3C-5E)		1540 -	2740	1380 -	2870
3C		N/A		130 -	260
3D		N/A		190 -	390
5A/B	Yellowmouth rockfish	N/A		460 -	980
5C/D		N/A		390 -	830
5E-S		N/A		100 -	210
5E-N		N/A		110 -	200
Coastwide (3C-5E)		500 -	900	520 -	950
3C		N/A		70 -	130
3D		N/A		40 -	70
5A/B	Rougheye rockfish	N/A		60 -	110
5C/D		N/A		90 -	160
5E-S		N/A		210 -	380
5E-N		N/A		50 -	100
Coastwide (3C-5E)		100 -	180	110 -	200
3C		N/A		20 -	40
3D		N/A		20 -	40
5A/B	Shortraker rockfish	N/A		10 -	20
5C/D		N/A		30 -	50
5E-S		N/A		20 -	30
5E-N		N/A		10 -	20
Coastwide (3C-5E)		490 -	870	490 -	850
3C		N/A		310 -	540
3D		N/A		80 -	140
5A/B	Shortspine thornyhead	N/A		20 -	30
5C/D		N/A		50 -	90
5E-S		N/A		10 -	20
5E-N		N/A		20 -	30
Coastwide (3C-5E)	** Longspine thornyhead	250 -	440	N/A	

** No yield options are given for longspine this year. We note that shortspine thornyheads accounted for almost all of the catch in 1996.

8.

8. Appendix 1. Participants at the Groundfish Subcommittee Meeting held 24-27 November 1997 at the Pacific Biological Station, Nanaimo, B.C.

NAME	AFFILIATION
Internal (DFO)	
R. Beamish*	Ocean Science & Productivity Division, PBS
P. Eveson	Ocean Science & Productivity Division, PBS
J. Fargo*	Stock Assessment Division, PBS
V. Haist*	Stock Assessment Division, PBS
R. Harbo	Fisheries Management, South Coast Division
D. Hay	Stock Assessment Division, PBS
M. Joyce	Aboriginal Fisheries Division, RHQ
R. Kronlund*	Stock Assessment Division, PBS
C. Ng*	Operations Branch, RHQ, Vancouver
S. McFarlane*	Stock Assessment Division, PBS
N Olsen*	Stock Assessment Division, PBS
H. Powles*	Biological Science Directorate, Ottawa
L. Richards	Stock Assessment Division, PBS
K. Rutherford	Stock Assessment Division, PBS
M. Saunders*	Stock Assessment Division, PBS
R. Stanley*	Stock Assessment Division, PBS
N. Surry	Stock Assessment Division, PBS
B. Turris*	Operations Branch, RHQ, Vancouver
J. Schnute*	Stock Assessment Division, PBS
J. Schweigert	Stock Assessment Division, PBS
M. Stocker	PSARC Chair, PBS
D. Trager*	Operations Branch, RHQ Vancouver
N. Venables*	Stock Assessment Division, PBS
D. Welch*	Chair, Groundfish PSARC Subcommittee
K. West	Fisheries Management, Fraser River Division
G. Workman	Stock Assessment Division, PBS
L. Yamanaka*	Stock Assessment Division, PBS

*member PSARC Groundfish Subcommittee

External	
R. Hilborn	School of Fisheries, University of Washington
J. Koolman	Hook and Line Sector
B. Fraumeni	Blackcod Fishermen Association
D. March	Canadian Groundfish and Research Society
M. Maunder	School of Fisheries, University of Washington
A. Sinclair	Gulf Fisheries Center, DFO, Moncton
C. Walters	Fisheries Center, University of British Columbia

9. Appendix 2. List of reviewers of working papers presented at the Groundfish Subcommittee Meeting 24-27 November 1997

REVIEWERS:

Internal (DFO):

R. Beamish	Ocean Science and Productivity Division, PBS, Nanaimo
A. Cass	Stock Assessment Division, PBS, Nanaimo
J. Fargo	Stock Assessment Division, PBS, Nanaimo
V. Haist	Stock Assessment Division, PBS, Nanaimo
D. Chen	Stock Assessment Division, PBS, Nanaimo
P. Eveson	Ocean Science and Productivity Division, PBS, Nanaimo
C. Hand	Stock Assessment Division, PBS, Nanaimo
R. Kronlund	Stock Assessment Division, PBS, Nanaimo
S. McKinnell	Ocean Science and Productivity Division, PBS, Nanaimo
S. McFarlane	Stock Assessment Division, PBS, Nanaimo
D. Noakes	Aquaculture Division, PBS, Nanaimo
N. Olsen	Stock Assessment Division, PBS, Nanaimo
I. Perry	Stock Assessment Division, PBS, Nanaimo
H. Powles	DFO, Ottawa
J. Rice	DFO. Ottawa
L. Richards	Stock Assessment Division, PBS, Nanaimo
J. Schweigert	Stock Assessment Division, PBS, Nanaimo
A. Sinclair	DFO, Moncton
R. Stanley	Stock Assessment Division, PBS, Nanaimo
M. Saunders	Stock Assessment Division, PBS, Nanaimo
L. Yamanaka	Stock Assessment Division, PBS, Nanaimo

External:

W. Clarke	International Pacific Halibut Commission, Seattle
R. Hilborn*	University of Washington, Seattle, Washington*
R. Methot	NW Fisheries Center, NMFS, Seattle
D. Murie	Inst. Of Food and Agricultural Sciences, Univ. of Florida
J. Tagart	Washington Dept. of Fish and Wildlife
C. Walters*	Fisheries Center, Univ. of British Columbia

* External reviewer and author (separate documents)

10. Appendix 3. Clarification of Advice on Inshore Rockfish

At the PSARC/RMEC meeting on January 14, 1998, RMEC raised the issue whether or not PSARC's concern about the status of Strait of Georgia inshore rockfish stocks was sufficient to recommend closure of the fishery in 1998.

The major concerns of PSARC are:

1. Most indicators of stock status indicate a downward trend in population size for inshore rockfish in most areas but there are significant uncertainties associated with rockfish biology that precludes making a firm statement about stock abundance or appropriate rates of removal at the present time.

2. Recreational and aboriginal catches are poorly known and need to be quantified.

3. Both the Subcommittee and Steering Committee reports concurred with the points raised in the assessment documents. At present, data limitations are least severe within the Strait of Georgia, and the Steering Committee supported the Subcommittee recommendation that substantial reductions in inshore rockfish harvest within the Strait of Georgia are needed, but also noted that there is no strong technical basis for recommending a specific level of harvest due to the biology of the species.

Although there is no immediate conservation concern RMEC is advised that managers need to begin plans to scale back total removals in 1998, particularly in the Strait of Georgia, and that work needs to be initiated to quickly establish the level of removals by all sectors of the fishery.